PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 148236.3DAB	**FOR FURTHER ACTION**	See Form PCT/IPEA/416
International application No. PCT/IL 03/00803	International filing date *(day/month/year)* 07.10.2003	Priority date *(day/month/year)* 07.10.2002
International Patent Classification (IPC) or national classification and IPC G11B17/00		
Applicant MEMPILE INC. ET AL.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 7 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:
   - ☒ Box No. I Basis of the opinion
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☒ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand 03.05.2004	Date of completion of this report 03.02.2005
Name and mailing address of the international preliminary examining authority: European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016	Authorized Officer Geoghegan, C Telephone No. +31 70 340-4295

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IL 03/00803

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
   - ☐ international search (under Rules 12.3 and 23.1(b))
   - ☐ publication of the international application (under Rule 12.4)
   - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages	
1-23	as originally filed
Claims, Numbers	
1-48	received on 21.10.2004 with letter of 21.10.2004
Drawings, Sheets	
1/3-3/3	as originally filed

   ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   - ☐ the description, pages
   - ☐ the claims, Nos.
   - ☐ the drawings, sheets/figs
   - ☐ the sequence listing *(specify)*:
   - ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/IL 03/00803

Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-48
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-48
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-48
	No:	Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:

D1: US-B1-6 291 132 (LEVICH EUGENE BORIS ET AL) 18 September 2001 (2001-09-18)

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):

> A method for use in recording/reading data from an array of data units within a three-dimensional storage medium, the method comprising:
> (a) providing exciting radiation in the form of first and second light beams of first and second different wavelengths, respectively (column 6, lines 13-24);
> (b) concurrently directing said first and second light beams and focusing them onto two sites in the medium at a predetermined distance between them, and collecting excited light of a third wavelength coming from the excited site in the medium to form a third excited light beam and direct it towards a detector assembly (column 12, line 67-column 13, lines 3) while correcting for spherical aberrations of the light focusing and collection;
> (c) sequentially repeating step (b) for successive sites in the medium with varying depth of focus (column 12, lines 46-48, and line 67-column 13 lines 6).

The subject-matter of claim 1 differs from D1 in that:
said focusing arrangement comprises two lens assemblies accommodated in an optical path of the exciting and excited light beams being arranged in a spaced-apart relationship along an optical axis of the focusing/collecting arrangement, one of said two lens assemblies being designed to perform the majority of light bending required for the focusing of the exciting light and collecting the excited light, and the other of said two lens assemblies being designed to compensate for changing spherical aberration introduced by a change in a thickness of the medium into which the exciting light is being focused.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as one of providing an alternative solution to correcting for spherical aberration. The spherical aberration of a particular optical setup is dependent on the nature of the material the light traverses and the length of the path through it. The present invention solves the problem of correction spherical aberration by the above differentiating features (two lenses assemblies).

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons: none of the prior art proposes such a solution to fully compensate for spherical aberration.

The same reasoning applies, mutatis mutandis, to the subject-matter of the corresponding independent claim 31, for a system, which therefore is also considered to be new and inventive.

Claims 2-30 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step. Claims 32-48 are dependent on claim 31 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

Notwithstanding the above reasoning, the attention of the Applicant is drawn to further objections. Dependent claims 18, 21, 22 and 32 do not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not clearly defined due to the use of the term "desired".

CLAIMS:

1. A method for use in recording/reading data from an array of data units within a three-dimensional storage medium, the method comprising:

(a) providing exciting radiation in the form of first and second light beams of first and second different wavelengths, respectively;

(b) concurrently directing said first and second light beams and focusing them onto two sites in the medium at a predetermined distance between them, and collecting excited light of a third wavelength coming from the excited site in the medium to form a third excited light beam and direct it towards a detector assembly, while correcting for chromatic and spherical aberrations of the light focusing and collection, said focusing comprising passing the exciting light beams through a focusing/collecting arrangement comprising two lens assemblies arranged in a spaced-apart relationship along an optical axis of the focusing/collecting arrangement, one of said two lens assemblies being configured to perform the majority of light bending required for the focusing of the exciting light, and the other of said two lens assemblies being configured to carry out the majority of compensation for changing spherical aberration introduced by a change in a thickness of the medium into which the exciting light is being focused;

(c) sequentially repeating step (b) for successive sites in the medium with varying depth of focus.

2. The method of Claim 1, wherein said collecting includes passing the excited light through the same focusing/collecting arrangement.

3. The method of Claim 1 or 2, wherein the focusing/collecting arrangement is configured and oriented relative to the medium and to light source and detector assemblies for focusing the exciting light beams to sites spaced from each other a predetermined distance and collecting the excited light from the excited site in the medium.

4. The method of any one of Claims 2 or 3, wherein said two lens assemblies are accommodated in the optical path of the exciting and excited light beams, said one of said two lens assemblies being designed to perform the majority of light bending required for the focusing of the exciting light and for collecting the excited light.

5. The method of any one of preceding Claims, wherein said lenses of the focusing/collecting arrangement have different surface geometries, at least one of these surfaces being aspheric.

6. The method of any one of preceding Claims, wherein that one of the two lens assemblies which is designed to compensate for changing spherical aberration is located closer to the medium.

7. The method of any one of preceding Claims, wherein each of said two lens assemblies comprises a single lens.

8. The method of any one of Claims 1 to 6, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is configured to define two lens portions of different materials and geometries.

9. The method of Claim 8, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis with a gap between them.

10. The method of Claim 8, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis and are attached to each other.

11. The method of any one of preceding Claims, wherein said lens assembly located closer to the medium includes a flying lens.

12. The method of any one Claim 6 or 8, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is located closer to the medium, the other one of the two lens assemblies being a multiple-lens assembly.

13. The method of any one of preceding Claims, wherein the varying of the depth of focus comprises displacing at least one of the lenses of the focusing/collecting

arrangement with respect to at least one other lens thereof along an optical axis defined by the focusing/collecting arrangement.

14. The method of Claim 13, comprising displacing the focusing/collecting arrangement with respect to the medium.

15. The method of any one of preceding Claims, wherein the varying of the depth of focus comprises varying the optical path lengths of the exciting light beams and the optical path of the excited light while propagating towards and away from the medium. respectively.

16. The method of Claim 15, comprising displacing light sources, detector and focusing/collecting arrangement with respect to the medium.

17. The method of Claim 15 or 16, comprising displacing the medium with respect to the focusing/collecting arrangement.

18. The method of any one of preceding Claims, wherein the correction of chromatic aberrations is carried out by pre-shaping the exciting beams so as to provide arrival of each of the excited beams to the focusing/collecting arrangement with a desired degree of the beam divergence/convergence, and by post-shaping of the excited beam so as to provide the excited beam arrival at a detector assembly with a desired degree of the excited beam divergence/convergence, while correction of spherical aberration is carried out substantially by the focusing/collecting arrangement.

19. The method of Claim 18, wherein said pre-shaping comprises providing a small degree of divergence/convergence of each of the first and second exciting light beams' arriving at the focusing/collecting arrangement, thereby providing semi-infinite conjugation of the first and second beams.

20. The method of Claim 18, wherein said pre-shaping comprises providing a large degree of divergence/convergence of each of the first and second exciting light beams when arriving at the focusing/collecting arrangement, so as to provide finite conjugation of the first and second exciting light beams.

21. The method of Claim 19 or 20, comprising passing each of the first and second exciting light beams through a lens assembly appropriately designed and oriented

with respect to a corresponding light source to provide the desired degree of the beam divergence/convergence.

22. The method of Claim 19 or 20, comprising accommodating the focusing/collecting arrangement at certain distances from first and second light sources generating said first and second light beams, to provide the desired degree of divergence/convergence of each of the first and second light beams when arriving at the focusing/collecting arrangement.

23. The method of Claim 16, wherein said pre-shaping comprises collimating one of the first and second exciting light beams and providing a small degree of divergence/convergence of the other of said first and second exciting beams when arriving at the focusing/collecting arrangement so as to provide semi-infinite conjugation of said other beam.

24. The method of Claim 18, wherein said pre-shaping comprises collimating each of said first and second exciting light beams, while propagating towards the focusing/collecting arrangement.

25. The method of any one of preceding Claims, wherein that one of the two lens assemblies of the focusing/collecting arrangement that is located closer to the medium is kept at a constant distance from the medium, and at least one other lens of the focusing/collecting arrangement is movable along the optical axis.

26. The method of any one of Claims 12 to 25, wherein said multiple-lens assembly comprises three lenses arranged in a spaced-apart relation along the optical axis.

27. The method of Claim 26, wherein said varying of the depth of focus comprises moving an intermediate one of said three lenses along the optical axis.

28. The method of any one of preceding Claims, wherein said first and second exciting beams are respectively reading and recording light beams.

29. The method of any one of Claims 1 to 27, wherein said first and second exciting beams are reading light beams.

30. The method of any one of Claims 1 to 27, wherein said first and second exciting beams are recording light beams.

31. An optical system for use in recording/reading data from an array of data units within a three-dimensional storage medium, the system being configured for correcting for aberrations of light focusing and collection, and comprising:

(a) a light source assembly operable to produce exciting radiation in the form of first and second light beams of first and second different wavelengths, respectively, thereby enabling excitation of sites in the medium to produce excited light of a third wavelength;

(b) a detector assembly for receiving the excited light and generating data indicative thereof;

(c) a focusing/collecting assembly configured to enable directing the exciting light beams and focusing them onto the sites spaced from each other a predetermined distance and for collecting the excited light to form an excited light beam to propagate towards the detector assembly, said focusing/collecting arrangement comprising two lens assemblies arranged in a spaced-apart relationship along an optical axis of the focusing/collecting arrangement, one of said two lens assemblies being configured to perform the majority of light bending required for the focusing of the exciting light and collecting the excited light, and the other of said two lens assemblies being configured to carry out the majority of compensation for changing spherical aberrations introduced by a change in a thickness of the medium into which the exciting light is being focused; and

(d) a drive means associated at least with the focusing/collecting arrangement to move at least one of lenses of the focusing/collecting arrangement along the optical axis of the focusing/collecting arrangement to thereby effect variation of a depth of focus, while the exciting radiation is applied to successive sites in the medium during a relative displacement between the system and the medium.

32. The system of Claim 31, comprising a beam shaping assembly accommodated in the optical paths of the first and second exciting beams and operating to pre-shape each of these beams to arrive at the focusing/collecting arrangement with

desired degree of divergence/convergence, and to post-shape the collected excited light beam while propagating towards the detector.

33. The system of Claim 31 or 32, wherein the lenses of the focusing/collecting arrangement have different surface geometries, at least one of these surfaces being aspheric.

34. The system of any one of Claims 31 to 33, wherein that one of the two lens assemblies which is designed to compensate for changing spherical aberration is located closer to the medium.

35. The system of Claim 34, wherein each of said two lens assemblies comprises a single lens.

36. The system of Claim 34, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is configured to define two lens portions of different materials and geometries.

37. The system of Claim 36, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis with a gap between them.

38. The system of Claim 36, wherein said lens portions are separate lens elements arranged in a spaced-apart relationship along the optical axis being attached to each other.

39. The system of any one of Claims 34 to 38, wherein said lens located closer to the medium is a flying lens.

40. The system of Claim 31, wherein that one of the two lens assemblies which is designed to perform the majority of light bending is located closer to the medium, the other one of the two lens assemblies being a multiple-lens assembly.

41. The system of Claim 37, wherein said multiple-lens assembly comprises three lenses arranged in a spaced-apart relation along the optical axis

42. The system of any one of Claims 31 to 41, wherein said drive means operates to displace that one of the two lens assemblies, which is designed to compensate for changing spherical aberration, along the optical axis.

43. The system of any one of Claim 31 to 42, wherein said drive means operates to move each of the two lens assemblies of the focusing/collecting arrangement along the optical axis.

44. The system of any one of Claims 32 to 43, wherein said beam shaping assembly comprises a lens assembly designed to provide a small degree of divergence/convergence of each of the first and second exciting light beams when arriving at the focusing/collecting arrangement to provide semi-infinite conjugation of each of said beams.

45. The system of any one of Claims 32 to 43, wherein said beam shaping assembly comprises a lens assembly designed to provide collimation of one of the first and second light beams and a small degree of divergence/convergence of the other of said first and second exciting beams when arriving at the focusing/collecting arrangement to thereby provide a semi-infinite conjugation of said other beam.

46. The system of any one of Claims 32 to 43, wherein said beam shaping assembly comprises collimating lenses in the optical paths of the first and second light beams, respectively, propagating towards the focusing/collecting arrangement.

47. The system of any one of Claims 32 to 43, wherein said beam shaping assembly comprises a lens assembly designed to provide a large degree of divergence/convergence of each of the first and second exciting light beams when arriving at the focusing/collecting arrangement to thereby provide finite conjugation of each of the first and second light beams.

48. The system of any one of Claims 31 to 47, comprising a lens assembly in the optical path of the first and second exciting beams generated by the light sources to affect the beams to provide substantially circular cross-section thereof.

This Page is Inserted by IFW Indexing and Scanning Operations and is not part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.